The Mental Health of Nuclear Submariners in the United States Navy

*Benjamin B. Weybrew, Ph.D.**
*Ernest M. Noddin, B.S.***

While conceptual and methodological problems of defining mental health and its presumed opposite, mental illness, have been considerable, some areas of agreement are beginning to appear among the many psychiatrists, psychologists, and social workers active in this field.[1,2] More and more, the most useful criterion of mental illness appears not only to be related to the incidence and severity of psychopathological symptoms but also, and perhaps more importantly, to the degree to which this symptomatology results in social dysfunctioning or, in extreme cases, social incapacitation. This "social-dysfunctional" criterion of mental health is particularly apropos the problem of adjustment of the 100 to 140 nuclear submarine crewmembers confined in close proximity to each other for extended submerged missions of 60 days or more.

The introduction of the deterrence concept with the launching of the first Fleet Ballistic Missile submarine in the early 60s accented not only the importance of careful psychiatric screening of all incoming submarine personnel but also the requirement for a continuing assessment of the mental health status of the entire crew. A series of official instructions issued by the Secretary of the Navy at that time further emphasized the criticality of maintaining the optimal mental health of the submarine crews, in order to minimize the likelihood of an inadvertent launch of a nuclear-armed missile or some other casualty, with ultimate consequences conceivably affecting the viability of the planet Earth.

Historically, the incidence of debilitative psychiatric illnesses in the Submarine Service has reportedly been incredibly small. For example, during World War II, the incidence of psychiatric casualties in the Submarine Service was reported to be 56 out of 126,160 manpatrols.[3] A somewhat larger but still relatively low psychiatric incidence rate of 20 per 1,000 in this branch of the Service was reported[4] about 10 years after Nautilus, the first nuclear submarine, was launched in 1954. This study indicated that about 24 per cent of the submariners referred for psychiatric evaluation were diagnosed as personality disorders, another 18 per cent neurotic, about seven per cent as psychotic, and the remainder undiagnosed.[4] The trend toward an increase in the psychiatric incidence rate of active duty personnel across all of the US Armed Forces seems to have peaked in the mid-70s.[5]

While the diagnostic classifications of the psychiatric cases reported in the above studies were arrived at largely by interview and other direct observational techniques, the present study involved the use of a well-standardized, psychodiagnostic test, the Minnesota Multiphasic Personality Inventory (MMPI), to identify the frequency and severity of psychopathological trends found in a large sample of submariner officers and enlisted men assigned to the nuclear submarines of the US Navy.

Materials and Methods

The population sample consisted of 1,103 submariners, 143 officers and 870 enlisted men, assigned to nuclear submarines of the US Navy. All of the men had volunteered as subjects for the Longitudinal Health Study, a prospective epidemiological study designed to provide comprehensive normative data for a variety of medical and psychological parameters. The age distribution for the enlisted segment of the sample showed a mean and standard deviation (S.D.) of 28 and six years, respectively. Calculation of the same statistics for the 143 officers in the study yielded a mean of 31 and a S.D. of eight years, the age differences between the two groups reaching significance at the one per cent confidence level (t-ratio). The enlisted segment showed a mean of 12.3 years of formal education (S.D. = 1.2 years) while the same statistics for the officer groups were 15.7 and 1.6 years listed in the same order. For the enlisted men, the distribution of verbal aptitude test scores obtained by the USN General Classification Test yielded a mean of 60.2 and a S.D. of 7.2 units. This compares with a Navywide mean of 50 and a S.D. of 10 units. As a whole, the total group had a mean of nine years active duty time (S.D. = six years).

Measurement Techniques

As stated earlier, the data base for this study was obtained by means of the Minnesota Multiphasic Personality Inventory (MMPI), an extensively validated objective personality test widely used in psychiatric practice in the United States.[6] This personality test consists of three validity scales and 10 diagnostic scales composed of 566 true/false items. The MMPI was selected for use in the present study for several reasons: (1) The MMPI has been used widely in clinical, industrial and educational situations for about 25 years; (2) validation data for diagnostic and for a variety of predictive purposes are readily available; and (3) a wide range of normative data originating from the submariner population are already in the literature.[7,8]

The test was administered to all of the subjects in groups of four or five under standardized conditions. The response protocols were hand-scored and the resulting score profiles statistically analyzed by computer.

Results

The score distributions for the 1,013 submariners, 143 officers and 870 enlisted men, for each of the 13 subtests of the MMPI were first examined for group differences. T-tests

*Chief, Personnel Assessment Division, Naval Submarine Medical Research Laboratory (NSMRL), New London, Groton, Conn. 06340.
**Staff psychologist, NSMRL.

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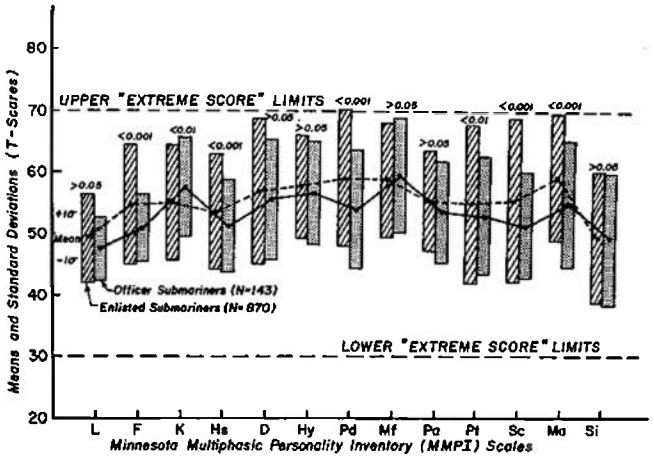

Fig. 1. Means and standard deviations (σ_s) for each scale of the MMPI. The null probabilities for the t-tests between the officer and enlisted sample means are placed above the bars for each subtest.

of the differences between the means for the officer and enlisted groups reached significance (one per cent confidence level) for two of the validity subtests and five of the diagnostic subtests. As a result of these differences, it was necessary to plot the T-score profiles separately for the two groups (Fig. 1).

At the outset, it is necessary to provide some description of the MMPI subtest content. Accordingly, the full scale title, its abbreviation, and a brief descriptive statement for each of the subtests follow: L, or Lie Scale, one of three validity scales, measures inordinate deceptive tendencies in responding to the test items; F-scale, tendency to exaggerate symptoms; K-scale, tendency to deny symptoms; Hypochrondriasis (Hs), over-concern about one's own health; Depression (D), tendency toward depressed mood; Hysteria (Hy), use of somatic symptoms as defenses; Psychopathic Deviate (Pd), tendency toward dyssocial conduct; Masculinity-femininity (Mf), degree of sex role identification; Paranoia (Pa), excessive suspiciousness; Psychasthenia (Pt), characterological or trait anxiety; Schizophrenia (Sc), degree of reality contact; Hypomania (Ma), level of psychic energy; Social Introversion (Si), social withdrawal.

It is seen in Fig. 1 that the line graphs of the means of both groups across the 13 MMPI scales lie well within the hypothetical upper and lower "extreme score" limits. This finding at once suggests the generally favorable mental health status of both the officer and enlisted submariners included in this study. A second general observation is the rather sizable amount of individual differences indicated by the magnitude of the standard deviations (σ_s) represented by the bar graphs for each scale for both the officer and enlisted groups. A third overall observation pertaining to the graphs in Fig. 1 has to do with the higher (.01 level by t-test) mean subtest scores obtained by the enlisted as compared with the officer submariner group for F, Hs, Pd, Mf, Pt, Sc and Ma. However, the σs were greater for the enlisted men as compared with officers only for F, Pt, and Sc (.05 level, F-ratio).

In order to provide additional clarity in discussing the personality types as defined by MMPI patterns, the data were also analyzed in such a way as to show more precisely the proportions of submariner samples with exaggerated subtest scores (Table I). Whereas the bar graphs representing $\pm$ one σ for each subtest assumes distribution symmetry (Fig. 1), it is a well known fact that the score distributions for virtually all of the so-called objective symptom tests, including the MMPI, tend to be slightly skewed positively, differing somewhat in terms of skewness from one subtest to another. Thus, the discussions of the submariner typology to follow will be based not only upon the position of the sub-test mean and the size of the σ (Fig. 1), but also upon the proportions of submariners with scores $\geqq$ than the upper "extreme score" norm conventionally set at T = 70 in Table I.

Test-taking Attitudes

The attitudes of the 1,013 submariners toward taking the MMPI test are reflected in the so-called LFK triad (Fig. 1).[10] Accordingly, the LFK triads for both officers and enlisted men were quite typical, and suggest that both groups were minimally resistive toward taking the test. Based upon the mean differences in Fig. 1, the enlisted group tended to be less defensive or inhibited than the officers, since their mean F-scale was above and the K-scale mean below the same statistics for the officer sample. However, the proportions of the two groups with scores on the LFK triad exceeding T = 70 (Table I) were not statistically significant, in spite of the fact that six per cent of the enlisted as compared with zero per cent of the officer group tended to overexaggerate the psychiatric symptomatology included in the F-scale items of the MMPI.

Emotional Stability

The literature dealing with MMPI research contains substantial data to support the general proposition that sizable elevations on scales Hs, D, and Hy, the so-called "neurotic triad," and, in addition, a tendency to "peak" on

TABLE I

Percentage of Officer and Enlisted Submariners with Elevated MMPI Subtest Scores

MMPI Subtests*	Percentage of Groups with T-Score ≥70 Enlisted Sample (N=870)	Officer Sample (N=143)
Validity Scales		
L-Scale	1.2	0
F-Scale	6.4	0
K-Scale	6.1	8.4
Clinical Scales		
Hypochrondriasis	6.7	2.7
Depression	14.8	9.1
Hysteria	5.7	2.1
Psychopathic Deviate	13.7	2.8†
Masculinity-Femininity	10.0	11.9
Paranoia	5.1	1.4
Psychasthenia	10.5	3.5†
Schizophrenia	10.5	1.4†
Hypomania	17.2	6.3†
Social Introversion	4.4	2.1

*See the Method Section for a description of these subtests.

†T-ratios between proportions in adjacent data column significant at the 1% level. Calculations made from tabled index numbers[9].

Pt, provide a useful pattern from which to gauge the general emotionality of a group of test respondents (see Methods section for test score content).[11]

It is seen (Fig. 1) that the enlisted group yielded higher mean scores on Hs and Pt and also tended to show greater individual differences (i.e., larger σs) than did the officer sample. These findings suggest the possibility that the younger enlisted submariners tend to be more concerned about their health (higher Hs) and tend to be chronically more anxious and tense (higher Pt), as compared with the officer segment included in the study. Considering the Hs/D/Hy triad as a whole, since the mean profiles for both groups fall between a T-score of 50 and 60, it may be assumed that the emotional characteristics of submarine crew members as measured by the MMPI reflect optimal psychiatric health. This assumption is certainly true except for a small proportion, three to 15 per cent, whose scores on D and Pt exceed the T = 70 upper limits indicated (Table I). A common MMPI dyad found in male US military veterans, the D/Pt personality type, occurred in 9.6 per cent of the enlisted men and in two per cent of the officers included in this study. The MMPI literature suggests that persons with this test score pattern tend to show depressive trends, elevated anxiety levels, more or less chronic, and to have very low stress tolerance.[12] It should be pointed out, however, that the D-scale of the MMPI measures depressed mood rather than clinical depression and as such is very unreliable,[13] fluctuating considerably over time. In contrast, Pt is very reliable and measures trait or characterological anxiety, the major presenting symptoms being the propensity for chronically elevated anxiety. Whether the presence of this trait contraindicates adequate adjustment for nuclear submariners is problematical. At what point does realistic caution and concern regarding the hazards of a submerged environment become the focussed anxiety of the phobic? Data bearing on the relationship between acute emotional symptoms developed during long submerged patrols and the hypothetical MMPI patterns discussed above are required to answer this question as posed.

Character Attributes

Throughout the brief history of psychiatry, the term "character" has been used as approximately synonymous with the term "personality." For the purpose of this paper, however, the expression "character attributes" refers to those traits which affect the interpersonal relationships, both favorably and unfavorably within selected groups, in this case, the submarine crew. Examples of character traits are the adjectives sociable, trustworthy, suspicious, withdrawn, to name a few. The MMPI literature provides rather substantial support for the validity of the Pd scale as a measure of general social adjustment, including attitudes toward family, towards authority, and towards the mores, rules, and regulations imposed by the social matrix; for example the submarine crew, to which the man is called upon to adapt.[8,11,13] Although lacking empirical verification in the submarine literature, clinical experience with Pd score patterns found in US Navy submariner and diver populations suggests that the scale measures in a negative direction a man's capacity for group loyalty, for assuming responsibility, and for sustained, reliable performance under stressful conditions.[8,14] Since this scale tends to be positively correlated with Pa and Ma, this triad as a whole appears to have considerable potential to identify persons capable of impulsive, uncontrolled, or aggressive behavior under certain circumstances. It is seen from the Pd and Ma distribution of enlisted men's scores that 14–17 per cent (depending on distribution symmetry) exceed T = 70 on one or the other scale (Table I). An actual count of the number of enlisted men with the Pd/Pa/Ma pattern exceeding T = 70 was 18 (3.7 per cent), while this percentage calculated only for the Pd/Ma dyad was 5.4 per cent. The percentage of the officer sample with these elevated score patterns was negligible. This fact may be in part the result of a high, negative correlation between Pd and amount of formal education.[15] With, on the average, four more years education than enlisted men, officers would be expected to obtain the lower Pd scores observed in Fig. 1. Taken together, these findings suggest that relatively few of the submarine crew members in this study had this trait configuration.

The more recent MMPI literature indicates that scale five, Mf, if elevated with the Pd/Ma dyad, acts as a suppressor variable on the tendency for impulsive, "acting-out" behavior characteristic of this personality type.[12] A count of the enlisted submariners with the elevated Pd/Ma pattern, together with an Mf score greater than 70, was nine, or about one per cent of the total. Thus, an estimate of the incidence of the sociopathic personality configuration as defined by the Pd/Ma dyad without the Mf suppressor component appears to be about four per cent in the enlisted submariner group and again virtually nonexistent in the officer segment.

Reality Appraisal

It has been said somewhat facetiously that the core problem of the emotionally unstable or neurotic person is that contact with reality is too close and overpowering, whereas the problem of the "character disorder" is that reality is largely ignored. On the other hand, the problem of the cognitively disturbed or psychotic is that reality tends to be misinterpreted and to be diffuse and obscure. For the nuclear submariner during a two-month submerged mission, the delicate line between reality over-evaluation, with resultant fear and anxiety, and reality under-evaluation with, in extreme cases, irrational and confused behavior, must be maintained by each crew member. The MMPI literature suggests several combinations of MMPI subtests with the Sc scale, which have been shown to be related to the degree of reality contact a person is able to attain and maintain.[11] In addition, assuming Ma is a measure of psychic energy, its combined elevation with Sc may indicate a serious psychological disturbance, the major presenting symptoms being confusion and disorientation. As before, extreme scores for these two scales occurred more frequently in the enlisted as compared with officer submariner group (Table I). By actual count, these two scales, Sc and Ma, tended to peak together for enlisted men in 18 cases or 2.1 per cent. This pattern was absent in the officer sample. Again, the literature would lead to the expectancy that the few persons with this profile would be hyperactive, tense, and somewhat confused from time to time during long submarine missions.[12] Further, if this dyad peak is accompanied by a

similar peak on Pt, one would expect a significant emotional "overlay" upon the somewhat fragile reality appraisal situation. However, this triad occurred very rarely in the present submariner sample, specifically in 14 enlisted men (1.6 per cent). A study designed to investigate the psychiatric health of a substantial sample of nuclear submariners after several years of submarine duty would be necessary to provide external validation for this and other personality types, the ultimate outcome being to provide psychiatric screening criteria for the 4,000 to 5,000 submariner candidates entering the Submarine Service annually.

Summary

The Minnesota Multiphasic Personality Inventory (MMPI) was administered to 1,013 crew members of nuclear submarines, 143 officers and 870 enlisted men, as a means of identifying personality "types" hypothetically predictive of psychopathological trends which may appear during long submarine missions. The results showed that officers as compared with enlisted men tended: (1) to be more defensive in responding to the test items; (2) to be less prone to be "over-concerned" with their physical health; (3) to be less likely to handle emotional distress by immature acting-out behavior; and (4) to show less intense emotional reactivity in general. These differences in MMPI patterns occur for at least two reasons. In the first place, the older officers with more formal education have been exposed to many more selection "screens" imposed by college or Naval Academy admissions boards than have the enlisted submariner candidates. In the second place, while the psychiatric screening criteria for officer and enlisted candidates for the submarine service are essentially the same, this "built-in" screening process apparently results in accepting more enlisted men with possibly maladjustive trends (as defined by the MMPI) than found in a comparable officer group.

Three trait clusters delineated by patterns of from two to five MMPI subtests were labelled Emotional Stability, Character Attributes, and Reality Appraisal. Found in less than five per cent of the enlisted and in virtually none of the officer sample, these three MMPI patterns, upon further validation, may provide a means for early identification of those few submariner candidates predisposed to significant psycholpatholoy during long patrols. As it now stands, and based mainly upon the MMPI data contained in this study, it can be concluded that the mental health of nuclear submariners as a whole is excellent.

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The Minnesota Multiphasic Personality Inventory (MMPI) was administered to 1013 crewmembers of nuclear submarines, 143 officers and 870 enlisted men, as a means of identifying personality "types" hypothetically predictive of psychopathological trends during long submarine missions. The results indicated considerable differences between submarine officers and enlisted men. Officers tended: (1) to be more defensive in responding to the test items, (2) to be less prone to be "over concerned" with their physical health, (3) to be less likely to

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handle emotional distress by immature acting-out behavior, and (4) to show less intense emotional reactivity. Found in less than 5% of the enlisted submariners, three trait clusters delineated by patterns of from two to five MMPI subtests were labelled Emotional Stability, Character Attributes, and Reality Appraisal. Based upon the MMPI literature, these three subtest configurations hypothetically identified submariner "types" for whom the probability of developing maladjustive trends during long patrols is slightly greater than zero. As a whole, however, the mental health of nuclear submarine crewmembers appears to be excellent.